

# Water Quality Analysis Using Physico-Chemical Parameters of Jakkur Lake in Bangalore North, Karnataka, India

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**Abstract-** This Paper deals with the Physico - chemical Parameters of Jakkur Lake in Bangalore North, Karnataka. Physical and Chemical Parameters such as Water Temperature, Turbidity, Total Dissolved Solids, pH, Dissolved Oxygen, Free Carbon dioxide and Total Hardness, Chlorides, Alkalinity, Phosphate and Nitrates were analyzed. All Parameters were within the permissible limit and hence found fit for domestic use.

**Keywords-** Perennial tank; Physico-Chemical Parameters, Monthly variation.

## I. INTRODUCTION

Water Quality can be defined as the chemical, physical and biological characteristics of water, usually in respect to its suitability for a designated use. The fresh water is of vital concern for mankind since it is directly linked to human welfare. Ground water is an important natural source of water supply all over the world. Its use in irrigation, industrial and domestic usage continues to increase where perennial surface water source are absent. The modern civilization, over exploitation, rapid industrialization and increased population has lead to fast degradation of our environment. As we all know, water has many uses, such as for recreation, drinking, fisheries, agriculture and industry. Each of these designated uses has different defined chemical, physical and biological standards necessary to support that use. For example, we expect higher standards for water we drink and swim in compared to that used in agriculture and industry.

Water quality standards are put in place to ensure the efficient use of water for a designated purpose. Water quality analysis is to measure the required parameters of water, following standard methods, to check whether they are in accordance with the standard.

Water quality analysis is required mainly for monitoring purpose. Some importance of such assessment includes:

1. To check whether the water quality is in compliance with the standards, and hence, suitable or not for the designated use.
2. To monitor the efficiency of a system, working for water quality maintenance
3. To check whether upgradation / change of an existing system is required and to decide what changes should take place.

The Jakkurlake is one of the largest water bodies in Bengaluru and is particularly special because it is a potential model for Integrated Urban Water Management (IUWM). This complex socio-ecological ecosystem highlights the symbolic relationship between nature and humankind. By serendipity, a sewage treatment plant (STP) with a capacity to treat 10 million litres a day was set up north of the lake by the government bodies. The plant currently releases 8 million litres of treated water into the man-made wetland which further purifies the water by a natural process before letting it enter the lake. Therefore the lake is fed with this treated water everyday, which in turn recharges the ground, increases the water table and fills up the bore-wells and the open wells.

## II. STUDY AREA

For the present study, an urban surface water body of Jakkurlake (fig 1) of Bengaluru city was selected. Jakkur is located at latitude 13°04' N and 77°36' E and is in the North-East corner of Bengaluru city and eastern side of NH-4 covers an area of 18.95 sq.km, the same is seen in SOI topo sheet No. 57G/12.

Bangalore district (Bangalore rural and urban districts) borders with Kolar and Chikkaballapur in the northeast, Tumkur in the northwest, Mandya and Ramanagaram in the southeast and Mysore and Tamil Nadu in the south. Bangalore urban district is bounded in all the

directions by Bangalore rural district except in southeast, where the district is bounded by Dharmapuri district of Tamil Nadu state. Bangalore urban district divided into three taluks namely Bangalore North, Bangalore South and Anekal (Fig. 1). Major part of the district (viz., Bangalore north and South taluks) is drained by Shimsha and Kanva rivers of Cauvery basin (Catchment area of 468 km<sup>2</sup>, which includes Nelamangala and Magaditaluks of Bangalore rural also). Anekal taluk is drained by South Pennar river of Ponnaiyar basin, which takes its birth from Nandi hills and flows toward south.

Bangalore is considered to be climatically a well favoured district. The climate of the district is classed as the seasonally dry tropical Savanna climate with four seasons. The main features of the climate of Bangalore are agreeable and favourable range of temperatures. The dry season with clear bright summer weather (December to February), is characterized by high temperatures (March to May), followed by the South-West monsoon season (June to September) and post-monsoon/retreating monsoon season (October to November). Two rainy seasons come one after the other but with opposite wind regimes, corresponding to the south-west and north-east monsoons. Typical monsoonal climate prevails in the district with major contribution of rainfall from southwest monsoon.



Fig1 Map showing Jakkur lake

### III. EXPERIMENTAL METHODS

#### WATER SAMPLING PROCEDURE AND ANALYSIS

The water samples were analysed for various parameters in the laboratory. Physical and chemical parameters like Temperature, pH, Turbidity, Total Dissolved Solids (TDS), Total Suspended Solids (TSS), Electrical Conductivity, Mineral Acidity, Total Hardness, Calcium, Magnesium, Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Chloride, Iron, Nitrates, Phosphates

and Alkalinity have been monitored for the lake water at different points and for bore wells.

Plastic cans of 5 liter capacity with stopper were used for collecting samples. Each bottle was washed with 2% Nitric acid and then rinsed three times with distilled water. The bottles were then preserved in a clean place. The bottles were filled leaving no air space, and then the bottle was sealed to prevent any leakage. Each container was clearly marked with the name and date of sampling.

#### SAMPLING POINTS

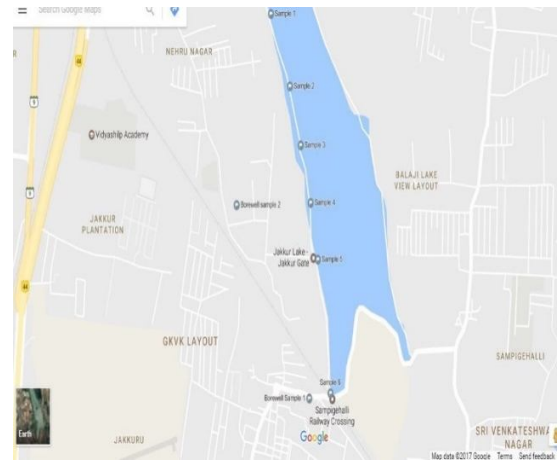


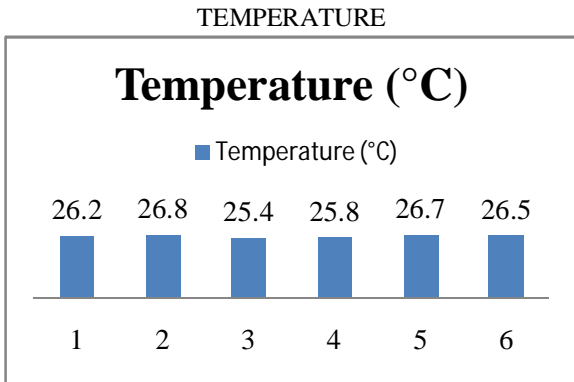
Fig 2 Map showing the sampling locations

### IV. MATERIALS AND METHODS

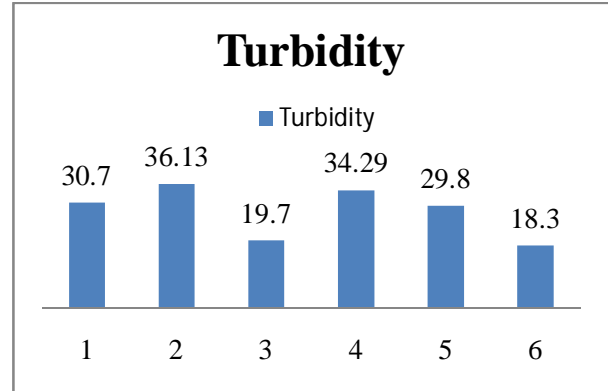
The Water Samples from Jakkur Lake were collected from two different stations in the morning hours between 10 to 12 am in Polythene bottle regularly for every month. The Water samples were immediately brought in to Laboratory for the Estimation of various Physico - chemical parameters, like water temperature and pH were recorded at the time of sample collection by using Thermometer and Pocket Digital pH Meter. While other Parameters Such as DO, TDS, Free CO<sub>2</sub>, Hardness, Alkalinity, Chlorides, Phosphate and Nitrate were estimated in the Laboratory by using Indian Standard Procedures (Titration method, Atomic Absorption Spectrophotometer (AAS) Thermo M5 Model) ( Trivedy and Goel,1986, APHA 1985).

### V. RESULTS AND DISCUSSION

The six samples obtained from the lake at the following six locations (map coordinates) were tested for pH, Temperature, Conductivity, Acidity, Alkalinity, Total Solids, Hardness and various salts and the result obtained are illustrated in the Charts below with Parameters on Y- axis and sample numbers on X – axis.

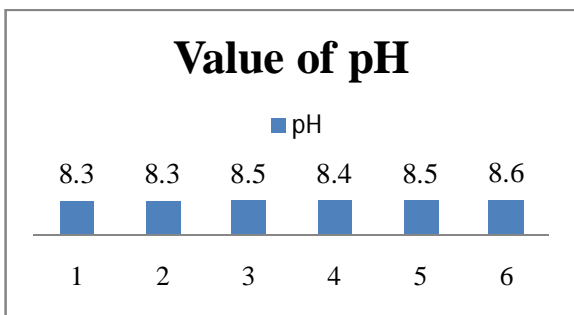


Graph 1 Variation of temperature at various points of lake



Graph3 Variation of turbidity at various points of lake

pH VALUE



Graph 2 Variation of pH at various points of lake

The pH is a measure of the intensity of acidity or alkalinity and measures the concentration of hydrogen ions in water. It has no direct adverse affect on health, however, a low value, below 4.0 will produce sour taste and higher value above 8.5 shows alkaline taste. A pH range of 6.5 to 8.5 is normally acceptable as per guidelines suggested by ISI. In the samples collected from lake varies between 8.3 to 8.6.

SAMPLES FROM LAKE:

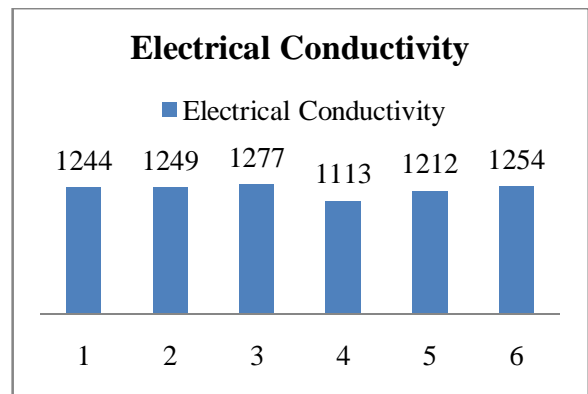
- Sample1: Location (13°05'29.4"N 77°36'25.3"E)
- Sample 2: Location (13°05'20.9"N 77°36'29.1"E)
- Sample 3: Location (13°05'14.1"N 77°36'31.3"E)
- Sample 4: Location (13°05'07.4"N 77°36'33.2"E)
- Sample 5: Location (13°05'00.7"N 77°36'34.7"E)
- Sample 6: Location (13°04'45.1"N 77°36'37.2"E)

TURBIDITY

Measurement of Turbidity reflects the transparency in water. It is caused by the substances present in water in suspension. The limit for Turbidity according to (BIS 1998): Desirable limits 5 NTU and Permissible limit of 10 NTU. In the samples obtained from lake water is found to be highly turbid in the range of (18.3 NTU - 36.13 NTU).

ELECTRICAL CONDUCTIVITY

Conductivity is a measure of water's capability to pass electrical flow. This ability is directly related to the concentration of ions in the water. These conductive ions come from dissolved salts and inorganic materials such as alkalis, chlorides, sulfides and carbonate compounds. According to BIS (1998) the desirable limit is 1000 µS/cm and permissible limit is 2000 µS/cm. The water samples from the lake are well within the permissible limits ranging from 1113 µS/cm – 1277 µS/cm.



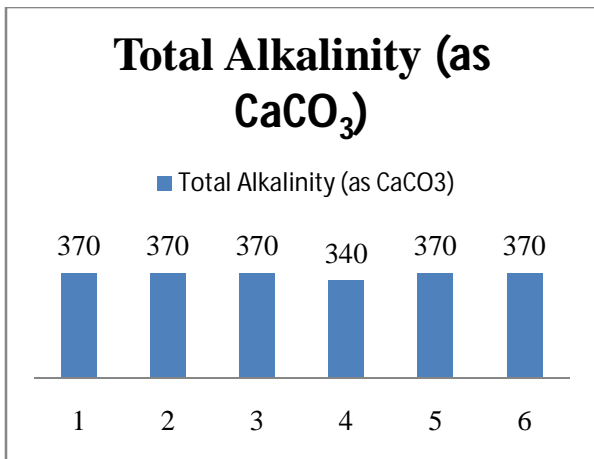
Graph 4Variation of Electrical Conductivity at various points of lake

MINERAL ACIDITY

Mineral acidity refers to the strength of mineral acids. Acidity is the ability of water to neutralize bases. A mineral acid is any inorganic acid such as: Hydrochloric acid, Nitric acid, Sulfuric acid, Phosphoric acid, Boric acid and Hydrofluoric acid. The samples obtained from lake has Zero mineral Acidity.

ALKALINITY

Alkalinity refers to the capability of water to neutralize acid. This is really an expression of buffering capacity. A buffer is a solution to which an acid can be added without changing the concentration of available H+ ions (without changing the pH) appreciably. According to BIS (1998) desirable limit is 200 and permissible limit is 600. The samples obtained from lakes are well within the permissible limit (340 – 370).

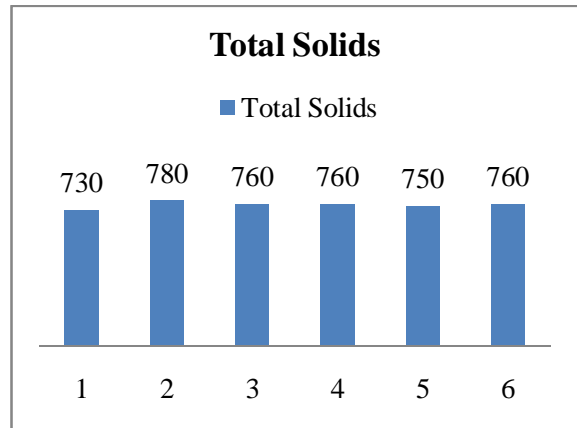


Graph5 Variation of alkalinity at various points of lake

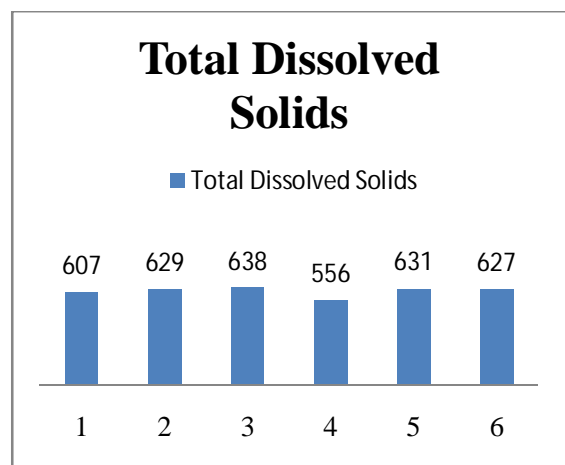
**TOTAL SOLIDS**

It can be defined as the material residue left in a vessel after evaporation of a sample and its subsequent drying in an oven at 103 to 105°C for one hour.

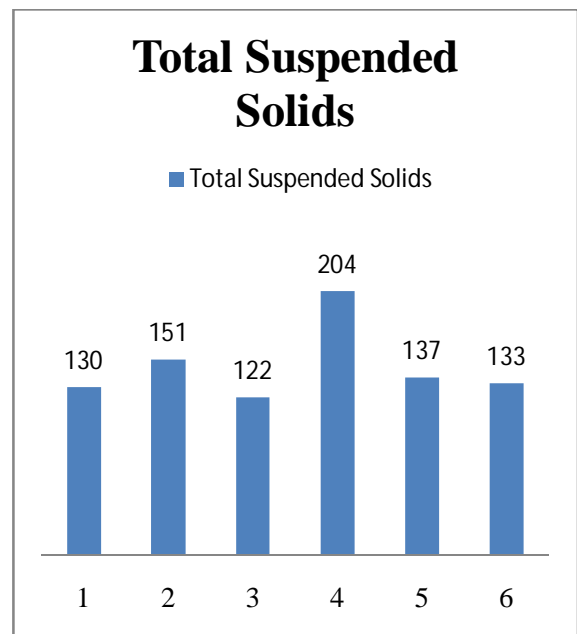
Total Dissolved Solids (TDS) are the total amount of mobile charged ions, including minerals, salts or metals dissolved in a given volume of water, expressed in units of mg per unit volume of water (mg/l) Total suspended solids (TSS) include all particles suspended in water which will not pass through a filter. Suspended solids are present in sanitary wastewater and many types of industrial wastewater. According to BIS (1998) the TDS has its desirable limit as 500 mg/l and permissible limit as 2000 mg/l. The samples obtained are well within the permissible limit.



Graph 6 Variation of Total Solids at different points of lake



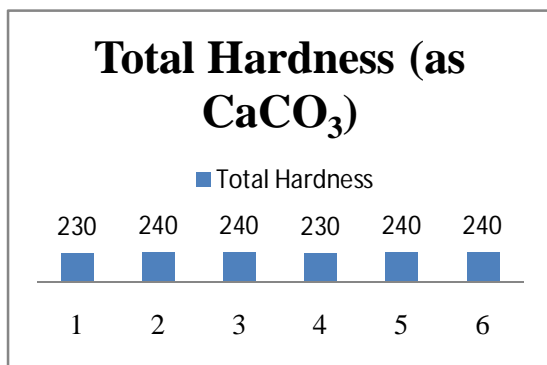
Graph 7 Variation of Total Dissolved Solids at different points of lake



Graph8 Variation of Total Suspended Solids at different points of lake

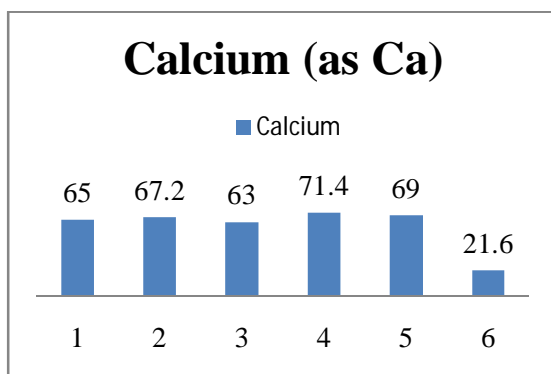
TOTAL HARDNESS

There are two types of water hardness they are Temporary and permanent hardness. Total hardness is defined as the sum of calcium hardness and magnesium hardness. Hard water contains dissolved magnesium and calcium ions. These make it more difficult for the water to form lather with soap. Temporary hardness is caused by dissolved calcium hydrogen carbonate (which is removed by boiling). Permanent hardness is caused by dissolved calcium sulfate (which is not removed by boiling). According to BIS (1998) the total hardness desirable limit is 300 mg/l and permissible limit is 600 mg/l. The samples are well within the permissible limit.



Graph 9 Variation of Total Hardness at different points of lake CALCIUM

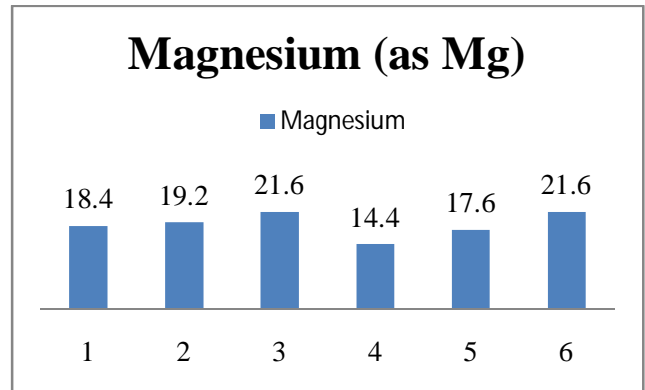
According to BIS (1998) the Calcium ions desirable limit is 75 mg/l and permissible limit is 200mg/l. The samples collected from the lake are under desirable limit.



Graph 10 Variation of Calcium ions at different points of lake

MAGNESIUM

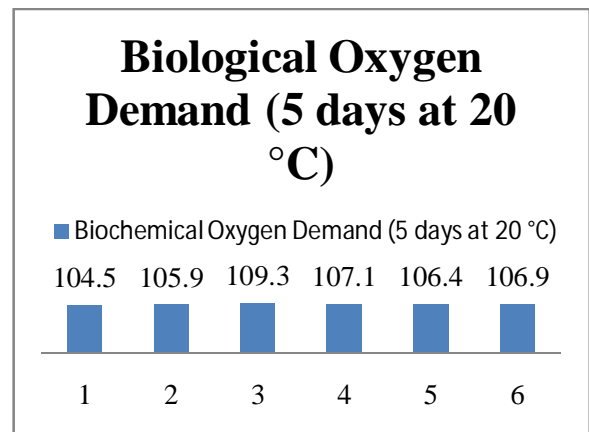
According to BIS (1998) the magnesium desirable limit is 30 mg/l and permissible limit is 100 mg/l. The samples are well within in the desirable limit.



Graph 11 Variation of Total Hardness at different points of lake

BIOLOGICAL OXYGEN DEMAND

Biochemical Oxygen Demand (BOD) refers to the amount of oxygen that would be consumed if all the organics in one liter of water were oxidized by bacteria and protozoa. If BOD is found to be 1 – 2 mg/l then there will not be much organic waste present in the water supply. If BOD is found to be between 3 – 5 mg/l then it is moderately clean. If it is 6 – 9 mg/l then the water is somewhat polluted. If BOD is found to be more than 100 mg/l then the water is highly polluted and contains organic waste. The BOD of a water let out by the treatment plants should be less than 5 mg/l. The samples collected from the lake indicate that the water is highly polluted

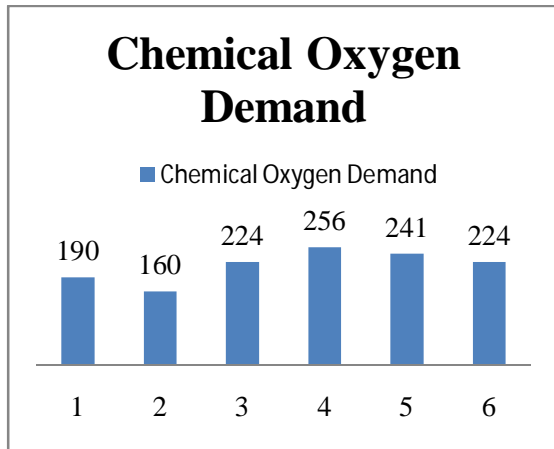


Graph 12 Variation of Total Hardness at different points of lake

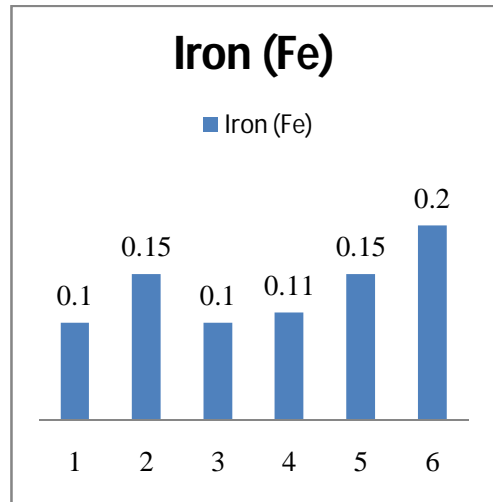
CHEMICAL OXYGEN DEMAND

Chemical Oxygen Demand (COD) is a measurement of the oxygen required to oxidize soluble and particulate organic matter in water. According to BIS (1998) the permissible limit is 250 mg/l. The samples obtained from lake

are within the permissible limit except for sample number 4 with 256 mg/l.



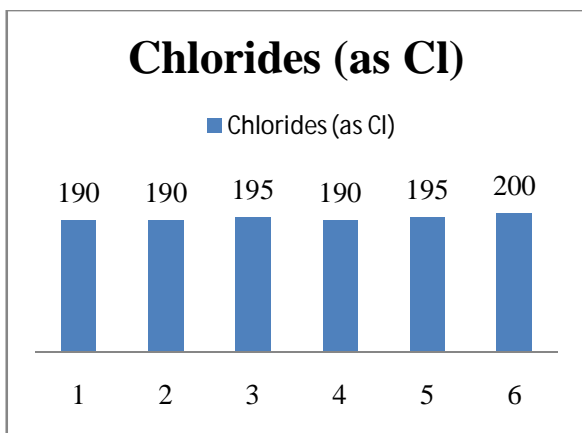
Graph 13 Variation of Chemical Oxygen Demand at different points of lake



Graph 15 Variation of Iron at different points of lake

CHLORIDES

According to BIS (1998) the desirable limit is 250 mg/l and the permissible limit is 1000 mg/l. beyond this limit taste corrosion and palatability are affected. The samples obtained from lake are under desirable limit.



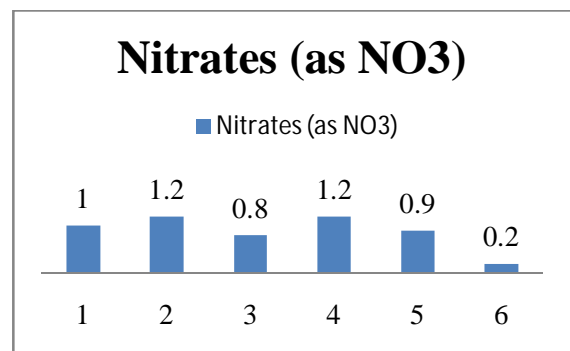
Graph 14 Variation of Chlorides at different points of lake

IRON

According to BIS (1998) the desirable limit is 0.3 mg/l and permissible limit is 1.0 mg/l. Beyond this limit taste/appearance are affected, has adverse effect on domestic uses and water supply structures, and promotes iron bacteria. The samples obtained from lake are well within the desirable limit.

NITRATES

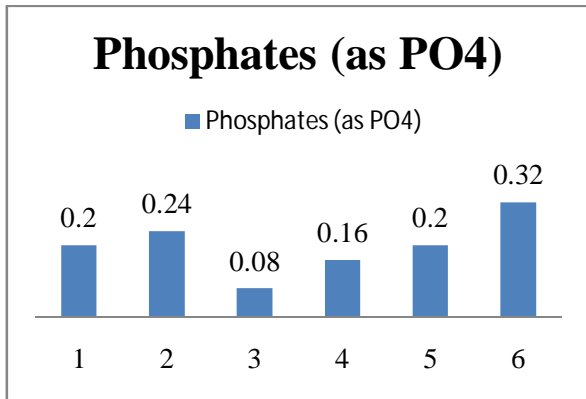
According to BIS (1998) the desirable limit is 45 mg/l and there is no relaxation. Beyond this value it indicates pollution. The samples obtained from lake are well within the desirable limit.



Graph 16 Variation of Nitrates at different points of lake

PHOSPHATES

According to BIS (1998) the desirable limit is 0.3 mg/l and there is no relaxation. The samples obtained from lake are well within the desirable limit except the sample number 6.



Graph 17 Variation of Phosphates at different points of lake

## V. CONCLUSION

The samples were collected from lake and bore wells, after the conduction of tests and obtaining the values of various parameters of all the samples, the average physical, chemical and biological characteristics of water vary from the usual water quality standards. The samples collected from lake have following average values such as pH at 8.4, turbidity - 28.15 mg/l, mineral acidity-0, alkalinity-365 mg/l, total solids-756.6 mg/l, hardness- 236.6 mg/l, calcium-59.5 mg/l, magnesium- 18.8 mg/l, BOD-106.8 mg/l, COD-215.6 mg/l, Chlorides-193.3 mg/l, Iron-2.1 mg/l, Nitrate-0.9 mg/l and Phosphate-0.2 mg/l.

Hence, according to the results obtained, the lake water is found to be highly turbid with even greater BOD and COD values than the permissible limits. Calcium, magnesium and chloride are found to be under the limit. Other parameters which include pH, alkalinity, total solids, hardness, iron and nitrate are found to be within the acceptable limits. The water collected from the bore well were well within the permissible limit and hence found fit for domestic use.

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